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TECHNICAL NOTE

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A METHOD OF DETERMINING THE EFFECT OF BLENDING BENTONITE ON PRODUCT VISCOSITY

by

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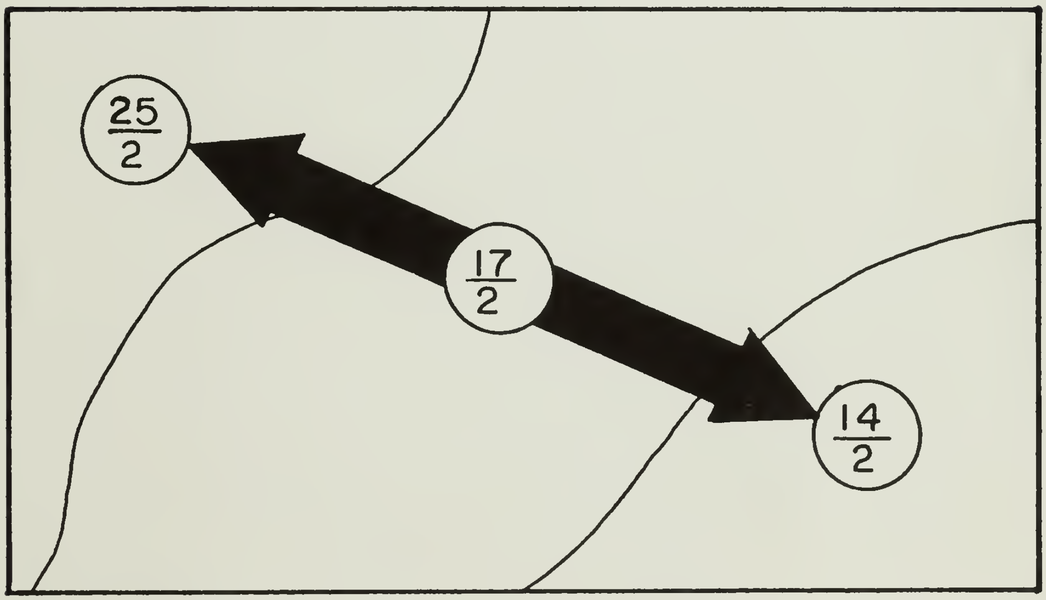

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A METHOD OF DETERMINING THE EFFECT OF BLENDING BENTONITE ON PRODUCT VISCOSITY

ABSTRACT

The Bureau of Land Management's standard criteria for evaluating bentonite allows for the provision of blending samples on a claim in order to achieve quality standards with the product of an interclaim blend (IM-77-226 VI.C, 1977). Samples of bentonite were collected from 21 sites, and run in 131 separate tests over ranges in viscosity, (11-114 barrel yield) and blend volume (1:1, 2:1, 3:1). An empirically based method is presented that will allow blending to be assessed in the Bureau's bentonite patent applications.

PREVIOUS INVESTIGATION

While qualitative estimates of the effect of blending bentonites have long been part of the bentonite mining industry jargon, little published material exists that treats the subject quantitatively. In fact only two unpublished quantitative analyses have been conducted to the authors' knowledge (by Sinclair (1977) and Fulton (1970)). Both of these analyses reached the conclusion that for a 1:1 volume-to-volume blend the effect of blending is to produce a barrel yield of slightly less than the calculated average yield of the components. These reports did not explore the results of blending at higher volume-to-volume ratios. In order to develop standard criteria for the evaluation of blending as per IM-77-226-VI.C, this study was conducted.

DATA COLLECTION AND ANALYSIS

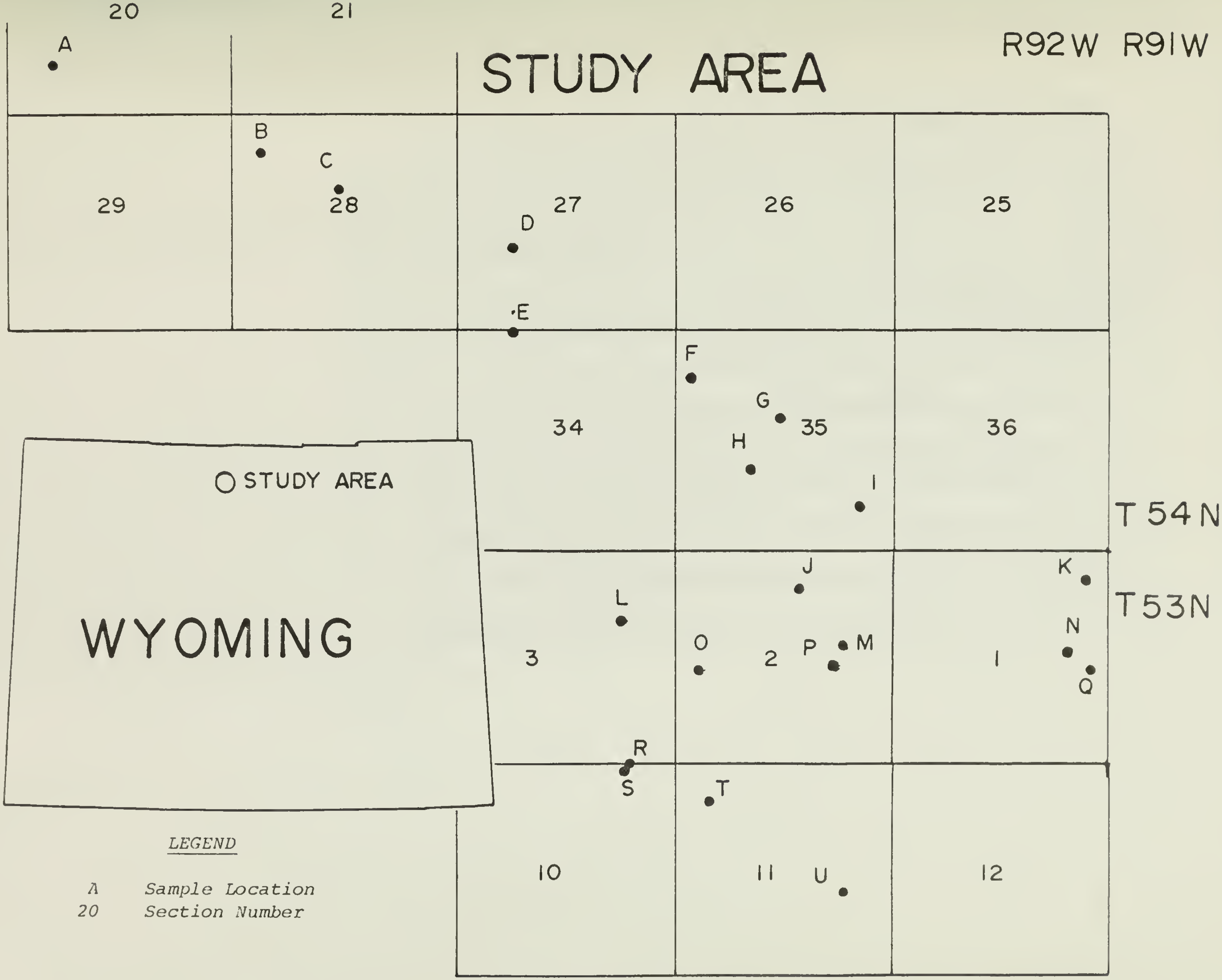
Twenty-one samples were selected from the sample storage facility at the BLM's Bentonite Laboratory in Worland, Wyoming, in order to represent a full range of potential viscosities (11-114 barrel yields) (Table 1). These samples were then volumetrically combined in 1:1, 2:1, and 3:1 ratios and 131 separate tests were run. The American Petroleum Institute (1974) procedures were followed during the analysis with the exception that sample moisture was corrected by adding fractional amounts of clay to ensure that exactly 22.4 g. of bentonite were added to 350 cm^3 of distilled water in order to limit the influence of effects other than the blending effect. The samples were all chosen from the uppermost bentonite bed of the Cretaceous Mowry Formation in a locality 12 miles northeast of the town of Greybull, Wyoming (Figure 1).

The results of the 131 tests conducted are given in Table 2. Regression analysis of the results of Table 2 revealed empirical relationships for each blend (Table 3). In order to illustrate the use of the relationships of Table 3 let us consider an example.

Table 1. Viscosity Properties of Samples Selected for Blending Test

Sample Number	VIS	BY
A	53	108
B	102	120
C	41	101
D	21	82
E	26	88
F	18	78
G	45	103
H	11	65
I	23	85
J	60	111
K	20	81
L	42	101
M	28	90
N	23	85
O	18	78
P	83	117
Q	12	68
R	64	112
S	32	94
T	43	102
U	114	122

VIS = Viscosity   BY = Barrel Yield


STUDY AREA
R92W R91W
T54N
T53N
20
21
29
28
27
26
25
34
35
36
3
2
1
10
11
12
A
B
C
D
E
F
G
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Q
R
S
T
U
WYOMING
STUDY AREA
LEGEND
A Sample Location
20 Section Number

Table 2. Results of Blending Component Samples

	1:1				2:1				3:1			
	VIS	BYT	BYE	DIF	VIS	BYT	BYE	DIF	VIS	BYT	BYE	DIF
B/H	27	89	93	-4	37	98	102	-4	54	108	107	+1
B/O	36	97	99	-2	47	105	106	-1	63	112	110	+2
B/E	45	103	104	-1	-	-	-	-	-	-	-	-
B/C	-	-	-	-	69	114	114	0	82	117	116	+1
B/M	-	-	-	-	94	119	110	+9	91	119	113	+6
B/R	77	116	116	0	77	116	118	-2	92	119	118	+1
E/T	31	93	95	-2	29	91	93	-2	28	90	92	-2
E/A	37	98	98	0	34	96	95	+1	31	93	93	0
E/C	34	96	95	+1	31	93	93	0	31	93	93	0
G/H	22	84	84	0	32	94	91	+3	33	95	94	+1
G/O	29	91	91	0	37	98	95	+3	51	107	97	+10
G/C	45	103	102	+1	54	108	103	+5	70	114	103	+11
G/R	57	110	108	+2	65	113	106	+7	72	115	106	+9
G/B	90	119	112	+7	71	115	109	+4	95	119	108	+11
G/P	66	113	110	+3	66	113	108	+5	61	111	107	+4
G/U	69	114	113	+1	62	112	110	+2	57	110	108	+2
G/M	47	105	97	+8	51	107	99	+8	48	105	100	+5
J/H	27	89	88	+1	36	97	96	+1	42	101	100	+1
J/O	28	90	95	-5	42	101	100	+1	45	103	103	0
J/C	28	90	106	-16	50	106	108	-2	54	108	109	-1
J/R	69	115	112	+3	63	112	112	0	67	113	112	+1
J/M	52	107	101	+6	57	110	104	+6	39	99	106	-7
O/Q	13	70	73	-3	14	71	75	-4	15	73	76	-3
O/L	29	91	90	+1	24	86	86	0	39	99	84	+15
O/N	21	82	82	0	19	80	81	-1	20	81	80	+1
O/C	27	89	90	-1	23	85	86	-1	22	84	84	0
O/K	17	76	80	-4	18	78	79	-1	18	78	79	-1
O/M	25	87	84	+3	29	91	82	+9	22	84	81	+3
O/I	19	80	82	-2	18	78	81	-3	18	78	80	-2
P/H	30	92	91	+1	37	98	101	-3	46	104	104	0
P/O	36	97	98	-1	47	105	104	+1	53	108	108	0
P/C	75	115	109	+6	84	117	112	+5	90	119	113	+6
P/R	66	113	115	-2	66	113	116	-3	63	112	116	-4
P/B	88	118	119	-1	86	118	118	0	86	118	118	0
P/M	48	105	104	+1	63	112	108	+4	60	111	111	0
R/H	22	84	89	-5	31	93	97	-4	36	97	101	-4
R/O	35	96	95	+1	43	102	101	+1	44	103	104	-1
R/E	42	101	100	+1	48	105	104	+1	49	106	106	0
U/H	37	98	94	+4	45	103	103	0	63	112	108	+4
U/O	44	103	100	+3	56	109	108	+1	63	112	111	+1
U/C	64	112	112	0	69	114	115	-1	76	116	117	-1
U/R	91	119	117	+2	72	115	119	-4	83	117	120	-3
U/B	99	120	121	-1	99	120	122	-2	98	120	120	0
U/P	103	120	120	0	93	119	121	-2	110	121	121	0
U/M	83	117	106	+11	91	119	112	+7	107	121	114	+7

VIS is the Fann viscosity at 600 r.p.m.
BYT is the theoretical barrel yield for blend
BYE is the experimentally derived barrel yield for blend
DIF is the difference between the BYT and the BYE.

Table 3. Empirical Relationships for Blending Ratios

Blend Ratio	Blending Relationship
1:1	$y = 0.71x^{1.07}$
2:1	$y = 1.13x^{0.97}$
3:1	$v = 1.03x$

x = Average of Component Barrel Yields

y = Actual Component Blend Product

Two bentonite samples have barrel yields 100 and 80 respectively. The expected 1:1 blend product, based on industry estimates would have a product yield of slightly less than or equal to 90 barrels. The empirical relationship (found in this paper in Table 3) for a 1:1 blend ($y=0.71\ x^{1.07}$) when used for this specific case gives a result of 87.56 barrels. The difference between the estimate and the experimental thus is approximately 3 barrel yield units.

The following results for each blend generally describe the effect blending has in comparison to the expected average yield of the components for the combination:

For 1:1 blends - Component average less 3 barrel yield units
2:1 blends - component average
3:1 blends - component average plus 2 barrel yield units.

SUMMARY AND CONCLUSIONS

It is now possible to assess component blends by using the relationships in Table 3 to get specific product yields or more generally to use the summary table above. The range of blend volumes tested in this study represents only a fraction of the possible blends which could be used by patent applicants; however, they do represent the most likely combination ratios. Further research into higher generation blends (greater than 3:1) as well as the initial studies into water loss blend product relationships will be investigated in the future.

References

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